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Effects of Southwestern Ponderosa Pine Mortality on Potential Wood Product Recovery

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No differences were found between the quality of trees killed by natural causes and of surviving trees. Mortality, primarily caused by lightning, was 18% of annual cubic foot volume increment.

Keywords: Wood properties, tree mortality, *Pinus ponderosa*

While some knowledge of southwestern ponderosa pine (*Pinus ponderosa*) mortality is available (Krauch 1930, Myers and Martin 1963, Pearson 1950, Schubert 1974, Wadsworth 1943), information on the effects of mortality on potential wood product recovery is incomplete. For example, it is not always known whether mortality will alter the proportions, or mix, of wood products that may be obtained by harvesting. This study was conducted to determine if the loss of ponderosa pine trees killed by natural causes (lightning, bark beetles, dwarf mistletoe, etc.) disproportionately affects potential wood product recovery.

Study Areas

Eight watersheds, along the Mogollon Rim, in northern and eastern Arizona, were chosen for the study. Six of the watersheds were on Beaver Creek, approximately 40 miles southeast of Flagstaff (fig. 1). Two watersheds were on the East and West Forks of Castle Creek, 20 miles south of Alpine.

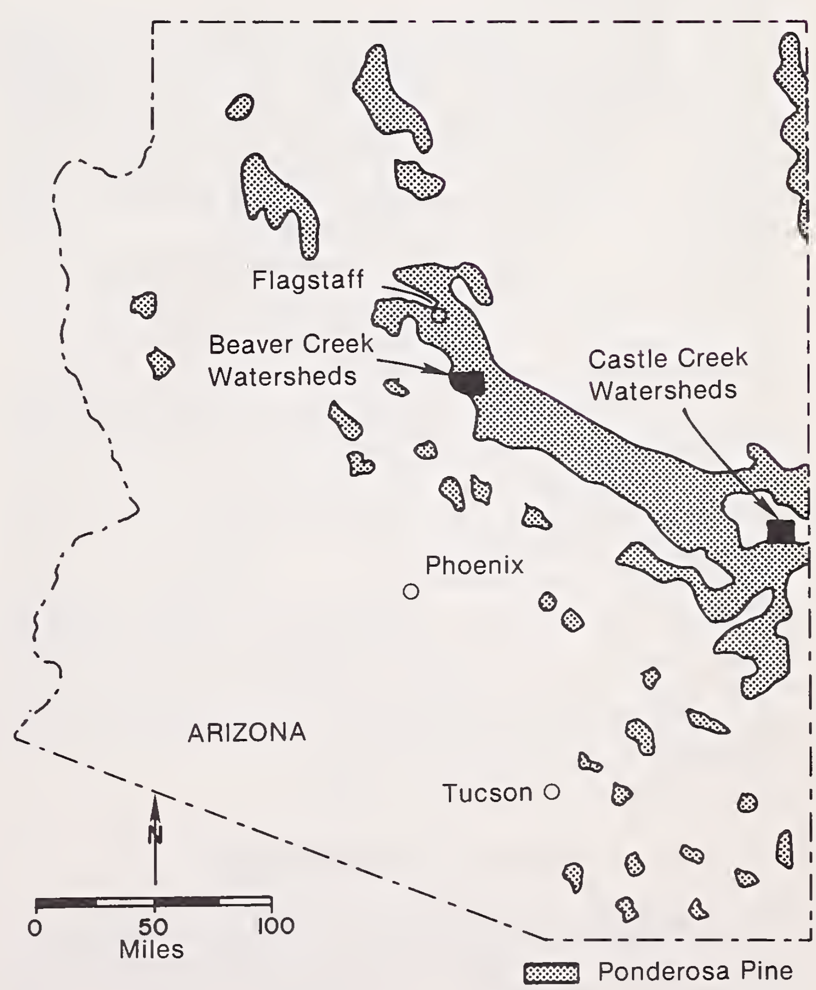

Figure 1.—Study area locations.

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The Beaver Creek sites represent cutover stands. The last timber was harvested on four watersheds, in the early 1950's, when 40% of the merchantable volume (trees at least 18 inches d.b.h.) was removed by group selection. The other two watersheds on Beaver Creek were uniformly thinned by group selection and a strip-shelterwood cutting, respectively, in the period 1969-70.

The East Fork of Castle Creek represents virgin conditions. On the West Fork, one-sixth of the forest overstory was clearcut, and the remaining five-sixths were thinned in 1965-66 to achieve optimum growth on residual trees.

All of the study areas predominantly supported ponderosa pine, with Gambel oak (*Quercus gambelii*) and alligator juniper (*Juniperus deppeana*) the primary associates on Beaver Creek, and Douglas-fir (*Pseudotsuga menziesii*) the primary associate on Castle Creek. Soils on the study areas were volcanic, principally basaltic. Slopes varied from 0% to 20%, and elevations ranged from 6,500 to 8,500 feet.

Methods

An initial inventory of the ponderosa pine forest overstories was made during 1963-65. Standard point sampling procedures, using an angle gage corresponding to a basal area factor (BAF) of 25, were used to sample 5,087 living trees (7 inches d.b.h. and larger), at 1,183 permanently established sample points. Basic stem characteristics and defects that affect potential wood product recovery (sweep, crook, scars, and log knots) were recorded.

During 1977-78, the inventory was repeated for each tree previously sampled, using the same procedures. As part of the reinventory, dead trees were noted, with one or more of the following causes of mortality recorded: lightning, bark beetles, dwarf mistletoe, heartrot, snow damage, windthrow, or unknown. The quality of dead trees was based on the earlier inventory.

Potential wood product recovery was estimated using computer program MULTI, a program to analyze wood product potentials in standing trees (Heidt et al. 1971). This program uses data on tree size, and stem characteristics and defects to produce output tables of volumes per acre by grade and size class for each wood product analyzed independently. Wood products considered in this study were commercial poles, saw logs, veneer logs, stud logs, and pulpwood.

Output tables generated from the 1977-78 inventory describing wood product potentials of trees killed by natural causes and of surviving trees were compared. For purposes of comparison, volumes per acre by grade and size class were expressed as a percent of the total volume estimated for each product.

Results and Discussion

No differences were found by chi-square analysis of output tables, for either dead or live trees, among the study areas. Therefore, the data from all study areas were pooled for subsequent analysis.

Most of the trees were killed by lightning (17%), which is common in southwestern ponderosa pine forests (Myers and Martin 1963, Pearson 1950, Schubert 1974). Bark beetles also contributed to mortality, either directly or secondarily by attacking trees weakened by lightning. Snow damage was a primary cause of mortality in small trees.

Average annual mortality of trees 7 inches d.b.h. and larger was 9.6 cubic feet per acre. This value represented about 18% of the gross increment, approximately that reported for southwestern ponderosa pine forests (Schubert 1974). Most of the lost volume occurred in larger trees, generally 22 inches d.b.h. and larger.

In general, there were no significant differences between potential wood product recoveries by volume, grade or class for trees killed by natural causes and for surviving trees, when volumes were expressed as a percent of total volume for each product. This finding can be illustrated by saw log potentials (fig. 2). Further, in both instances, the proportions of tree volumes per acre, by grade and size class potentially suited for wood products, were similar to those previously reported for southwestern ponderosa pine forests (Barger and Ffolliott 1970).

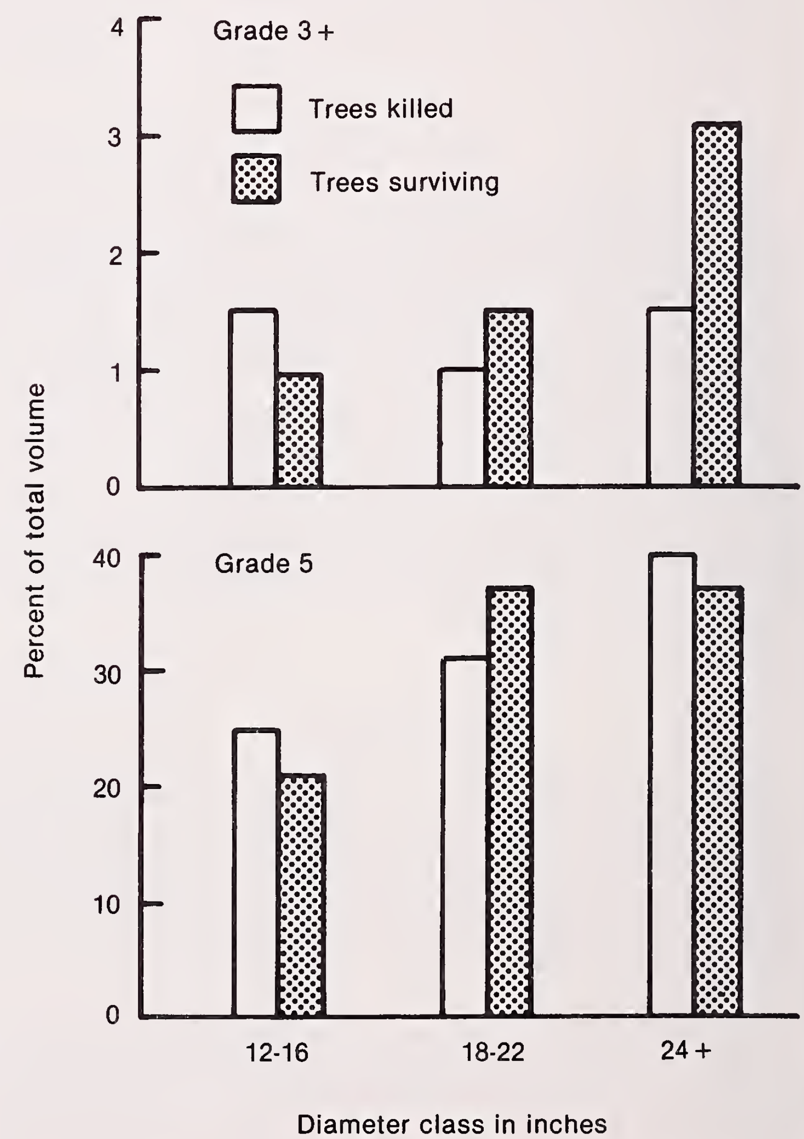

Figure 2.—Saw log potentials of trees killed by natural causes and of surviving trees.

As long as dead stems are standing and are not excluded from consideration for a wood product by definition, recent mortality (up to 10 years) will not affect wood product potentials. However, dead trees eventually deteriorate, reducing net wood product recovery. The policy of reserving two to three pine snags per acre for cavity-nesting birds (Scott 1979) will also reduce net recovery.

The results of this study indicate that mortality has little effect on the proportion of potential wood products recoverable from southwestern ponderosa pine forests.

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